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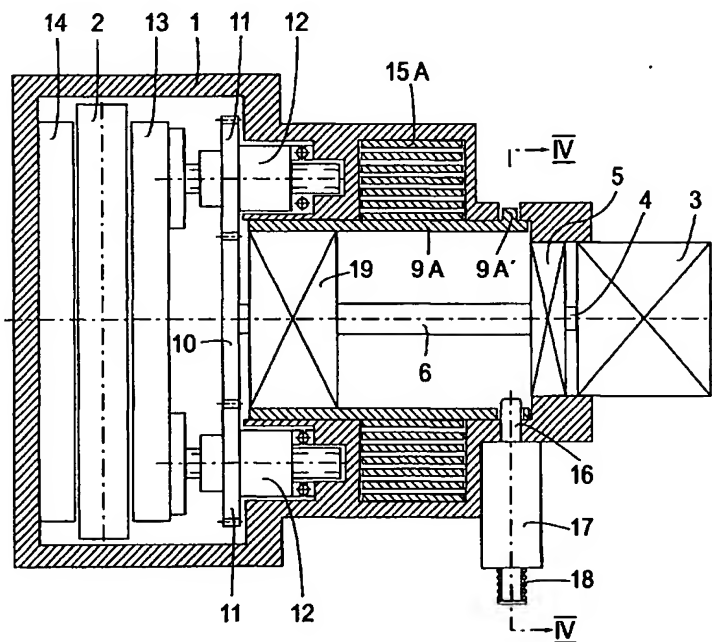
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(54) Title: A PARKING BRAKE ARRANGEMENT IN AN ELECTRICALLY OPERATED BRAKE



(57) Abstract: In a parking brake arrangement in an electrically operated brake, a rotary movement of an electric motor (3) is transformed into a translational brake applying movement. An engageable or disengageable elasticity spring (15; 15A) for providing a parking brake force when engaged is so arranged in the force transmitting chain that its elasticity is in series with the elasticity of the brake.

WO 03/052286 A1



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A PARKING BRAKE ARRANGEMENT IN AN ELECTRICALLY OPERATED BRAKE

5. Technical Field

The present invention relates to a parking brake arrangement in an electrically operated brake, in which a rotary movement of an electric motor is transformed into a translational brake applying movement.

10 Background of the Invention

There is a tendency to employ an electric drive motor as the means for operating a brake actuator for a vehicle. In the present case this electric motor is used for operating a disc brake, especially but not exclusively for
15 a heavy road vehicle, such as a truck, trailer, or bus. This disc brake contains means for transforming the rotational movement of the electric motor into a translational movement of a brake pad.

The electric motor can be used not only for service
20 braking but also for parking braking. In the latter case the brake is applied by the electric motor to a force which is suitable for safely holding the vehicle in the parked position and is held in this applied condition.

A problem may, however, be encountered in that the
25 brake disc and certain portions of the disc brake may have been heated to considerable temperatures during the preceding service braking. When the heated members gradually cool off and return to normal size after their heat expansion, the parking brake force may decrease to
30 such a level that the safe parking braking may be jeopardized.

The Invention

The problem of ensuring a satisfactory parking
braking when the heated members cool off may be solved according to
35 the invention by an elasticity spring, which is so arranged in the force transmitting chain that its

elasticity is in series with the elasticity of the brake and is adapted to provide a rotary parking brake force.

The elasticity spring is preferably loaded at a service brake application of the brake and then locked
5 until released for parking brake application.

A practical embodiment is characterized in that a transmission sleeve rotatably biased by the elasticity spring is rotatably arranged in the rotary force transmitting chain in the housing of the brake and is held
10 to the housing at service braking but is disengaged therefrom at parking braking.

Hereby, the force of the elasticity spring is transmitted via the transmission sleeve to the brake pad only at parking braking. The elasticity spring may provide
15 a force which is suitable for parking braking.

For practically accomplishing the engagement and disengagement of the transmission sleeve there is a locking rod, which is arranged in the housing for engagement with the transmission sleeve by means of an electromagnet and
20 disengagement therefrom by means of a compression spring.

The elasticity spring may either be a compression spring connected to the transmission sleeve by means of a sleeve arm or a clock spring or spiral spring arranged in the housing with its outer end attached to the housing and
25 its inner end attached to the transmission sleeve.

Brief Description of the Drawings

The invention will be described in further detail below under reference to the accompanying drawings, in
30 which

Fig 1 is a sectional side-view and Fig 2 is a section along the line II-II in Fig 1 of a first embodiment of an electric disc brake according to the invention,

Fig 3 is a sectional side-view and Fig 4 is a section along the line IV-IV in Fig 3 of a second embodiment of an electric disc brake according to the invention, and

Fig 5 is a sectional side-view and Fig 6 is a section along the line VI-VI in Fig 5 of a third embodiment of an electric disc brake according to the invention.

Detailed Description of Embodiments

The first embodiment according to Figs 1 and 2

A disc brake according to the invention is very schematically shown in Fig 1. A disc brake caliper or housing 1 is to be mounted astraddle of a brake disc 2 on a vehicle axle. The vehicle is preferably but not exclusively a heavy road vehicle, such as a bus, a truck, or a trailer.

An electric motor 3 is attached to the caliper 1. Its drive shaft 4, which may be rotated in either direction by the motor 3, is connected to a coupling 5 of the kind that keeps its outgoing coupling shaft 6 non-rotatable or braked, in a brake release direction, when no current is supplied to the motor 3.

The coupling shaft 6 is provided with a gear 7 in gear engagement with a planet gear 8, which is also in gear engagement with a transmission sleeve 9 to be described below. The planet gear 8 is rotatably arranged on an intermediate gear 10, rotatably arranged in the caliper 1. By this exemplary arrangement the rotational speed of the intermediate gear 10 is reduced in relation to that of the coupling shaft 6. Other reduction arrangements, for example in more than one stage, are possible.

The intermediate gear 10 is in gear engagement with a thrust rod gear 11 of each of two thrust rods 12. The thrust rods 12 have the general function of transforming the ingoing rotational movement of the gear 11 into an outgoing linear movement of a part connected to a first disc brake pad 13 at one side of the brake disc 2. At the other side of the brake disc 2 there is a second disc brake

pad 14 connected to the caliper 1, which in this case is of the so called floating type, i e it is mounted for certain movements perpendicularly to the disc 2. The caliper may, however, equally well be of the fixed type.

5 With the briefly described design the first disc brake pad 13 will be applied against the brake disc 2, when the motor 3 is rotated in its application direction. At a motor rotation in the opposite direction the disc brake pad 13 will be withdrawn from the brake disc 2.

10 The transmission sleeve 9 is rotatable in the caliper 1 and is provided with a sleeve arm 9' extending out of the caliper 1 trough a slot 1' having an end shoulder 1", against which the sleeve arm 9' is shown to be resting in Fig 2.

15 An elasticity spring 15 fixedly supported to the left in Fig 2 (in a way not shown) exerts a bias to the right on the sleeve arm 9'.

20 A locking rod 16 axially movably arranged in the caliper 1 is arranged for locking cooperation with a corresponding opening 9" in the transmission sleeve 9. The locking rod 16 is brought into engagement with the opening 9" by an electromagnet 17 when energized and biased by a compression spring 18 in the return direction.

First service brake application

25 Initially, for example after the installation of new brake pads 13 and 14, the locking rod 16 is out of engagement with the transmission sleeve 9 and the elasticity spring 15 is released, so that the transmission sleeve is rotatably biased to the right in Fig 2.

30 The disc brake is applied in a normal way by rotation of the electric motor 3 in its application direction. During this application the electromagnet 17 is energized, so that the locking rod 16 strives for getting into engagement with the transmission sleeve 9.

When the brake force reaches a level corresponding to the bias of the elasticity spring 15, the spring is compressed, and the transmission sleeve 9 is rotated, until the sleeve arm 9' engages the slot shoulder 1" and the
5 locking rod 16 engages the transmission sleeve 9.

At a subsequent release of the brake to a force below the bias of the elasticity spring 15, the locking rod 16 will be clamped in an engaged position in the transmission sleeve 9, which means that the engaged, shown position will
10 remain even at a current loss for the brake system.

Normal brake operation

In normal operation the different parts are in the positions shown in Figs 1 and 2 with the electromagnet 17 energized and the locking rod 16 in locking engagement with
15 the transmission sleeve 9. Also, the elasticity spring 15 is in a compressed state.

The disc brake is applied and released by rotating the electric motor 3 in either direction (without any influence from the elasticity spring 15, as the
20 transmission sleeve 9 is held stationary).

Parking brake application

The disc brake is applied by the electric motor 3 to a force which is somewhat higher than the bias of the elasticity spring 15, and the electromagnet 17 is de-
25 energized.

In this situation the compression spring 18 is able to withdraw the locking rod 16 from engagement with the transmission sleeve 9.

The elasticity spring 15 is now in the force
30 transmitting chain. If the parking brake force decreases under the force of the elasticity spring 15, only the elasticity spring will provide the braking force.

The movement of the locking rod 16 can be monitored by the electronics of the brake system, so that it can be
35 verified that the correct force has been attained and that

extra elasticity is available. Differently stated, the fact that the locking rod 16 is withdrawn or pulled out (under the bias of the compression spring 18) is a verification that the parking brake functions and that a brake force is available.

Parking brake release

When the parking brake is to be released the electromagnet 17 is energized. The brake is applied to a force which is somewhat higher than the bias of the elasticity spring 15, and the locking rod 16 engages the transmission sleeve 9.

The second embodiment according to Figs 3 and 4

The main difference between the second and the first embodiments is that the former has an elasticity spring in the form of a clock spring or spiral spring instead of a compression spring.

Parts that are similar in the two embodiments have the same reference numerals. This is true for the disc brake caliper 1, the brake disc 2, the electric motor 3, the drive shaft 4, the coupling 5, the coupling shaft 6, the intermediate gear 10, the thrust rod gears 11, the thrust rods 12, the disc brake pads 13 and 14, the locking rod 16, the electromagnet 17, and the compression spring 18.

A modified transmission sleeve is given the reference numeral 9A, and the modified elasticity spring is given the reference numeral 15A.

In this embodiment the rotational speed reduction from the coupling shaft 7 to the intermediate gear 10 is performed by a gear box 19, preferably a planetary gear box, in the transmission sleeve 9A.

The transmission sleeve 9A has a protrusion 9A', extending into a caliper slot 1A' having an end shoulder 1A'', and an opening 9A'' for the locking pin 16.

The outer end of the elasticity spring 15A is attached to the caliper 1 and the inner end to the transmission sleeve 9A.

The function of the brake according to the second embodiment is the same as that of the first embodiment, and the description thereof is not repeated.

The third embodiment according to Figs 5 and 6

The third embodiment according to Figs 5 and 6 has closest similarities with the first embodiment. The principal difference in relation thereto is that the third embodiment has only one thrust rod instead of two.

Again, parts that are similar in these two embodiments have the same numerals. This is true for the brake caliper 1, the brake disc 2, the electric motor 3, the drive shaft 4, the coupling 5, the gear 7, the planet gear 8, the disc brake pads 13 and 14, the elasticity spring 15, the locking pin 16, the electromagnet 17, and the compression spring 18.

The planet gear 8 is rotatably arranged on a thrust rod ring 11B (journalled in the caliper 1) of the single thrust rod 12B. The coupling shaft 6B with the gear 7 is sleeve-shaped in order to accomodate the thrust rod 12B.

The function of this embodiment is the same as that of the first embodiment.

An alternative function of the arrangement is to have the elasticity spring 15; 15A locked in unloaded state at service brake application of the brake. At a parking brake application the unlocked elasticity spring is loaded by the electric motor 3 and used for parking brake application.

Modifications are possible within the scope of the appended claims. It would for example be possible to make use of the basic thought behind the invention not only for a disc brake but also for a drum or block brake, and the invention is not limited to brakes for heavy road vehicles.

CLAIMS

1. A parking brake arrangement in an electrically operated brake, in which a rotary movement of an electric motor (3) is transformed into a translational brake applying movement, c h a r a c t e r i z e d by an elasticity spring (15; 15A) so arranged in the force transmitting chain that its elasticity is in series with the elasticity of the brake and adapted to provide a rotary parking brake force,

10 2. An arrangement according to claim 1, c h a r a c t e r i z e d in that the elasticity spring (15; 15A) is loaded at a service brake application of the brake and then locked until released for parking brake application.

15 3. An arrangement according to claim 1, c h a r a c t e r i z e d in that the elasticity spring (15; 15A) at service brake application of the brake is locked in unloaded state and at parking brake application is loaded by the electric motor (3) and used for parking brake application.

20 4. An arrangement according to claim 1, c h a r a c t e r i z e d in that a transmission sleeve (9; 9A) rotatably biased by the elasticity spring (15; 15A) is rotatably arranged in the rotary force transmitting chain of the brake and is held to a non-rotatable part of the
25 brake at service braking but is disengaged therefrom at parking braking.

5. An arrangement according to claim 4, c h a r a c t e r i z e d in that the transmission sleeve (9; 9A) is rotatably arranged in the housing (1) of the brake and is
30 held to the housing at service braking.

6. An arrangement according to claim 4, c h a r a c t e r i z e d by an electrically activated locking device (16) for the transmission sleeve (9; 9A).

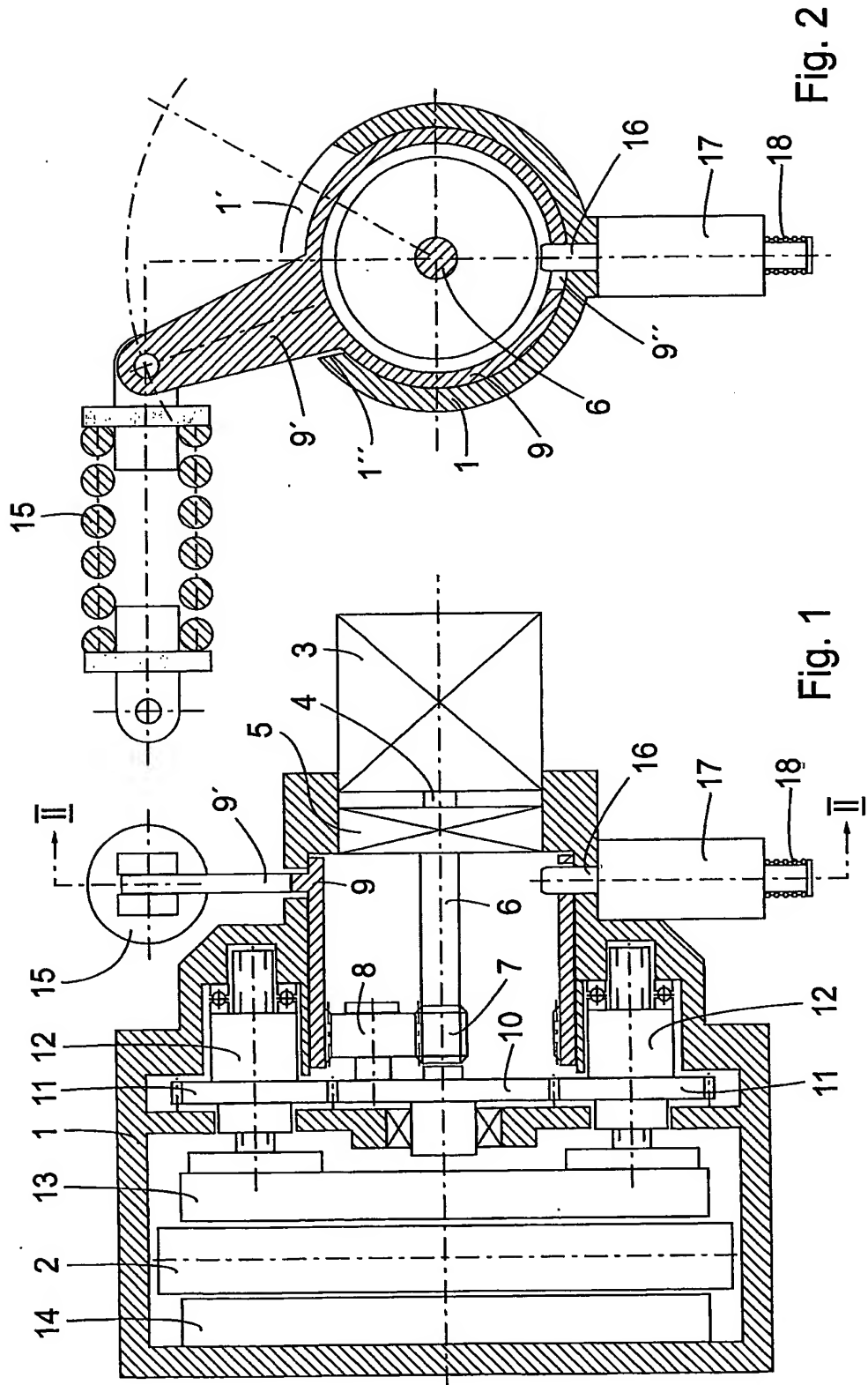
7. An arrangement according to claim 6, c h a r a c t e r i z e d by a locking rod (16), which is arranged in
35

the housing (1) for engagement with the transmission sleeve (9; 9A) by means of an electromagnet (17) and disengagement therefrom by means of a compression spring (18).

8. An arrangement according to any of claims 1-7,
5 c h a r a c t e r i z e d in that the elasticity spring is a compression spring (15) connected to the transmission sleeve (9) by means of a sleeve arm (9').

9. An arrangement according to any of claims 1-7,
c h a r a c t e r i z e d in that the elasticity spring is
10 a clock spring or spiral spring (15A) arranged in the housing (1) with its outer end attached to the housing and its inner end attached to the transmission sleeve (9A).

10. An arrangement according to claim 4, c h a r a c -
t e r i z e d by means for monitoring the movement of the
15 locking rod (16) so as to verify the function of the arrangement.



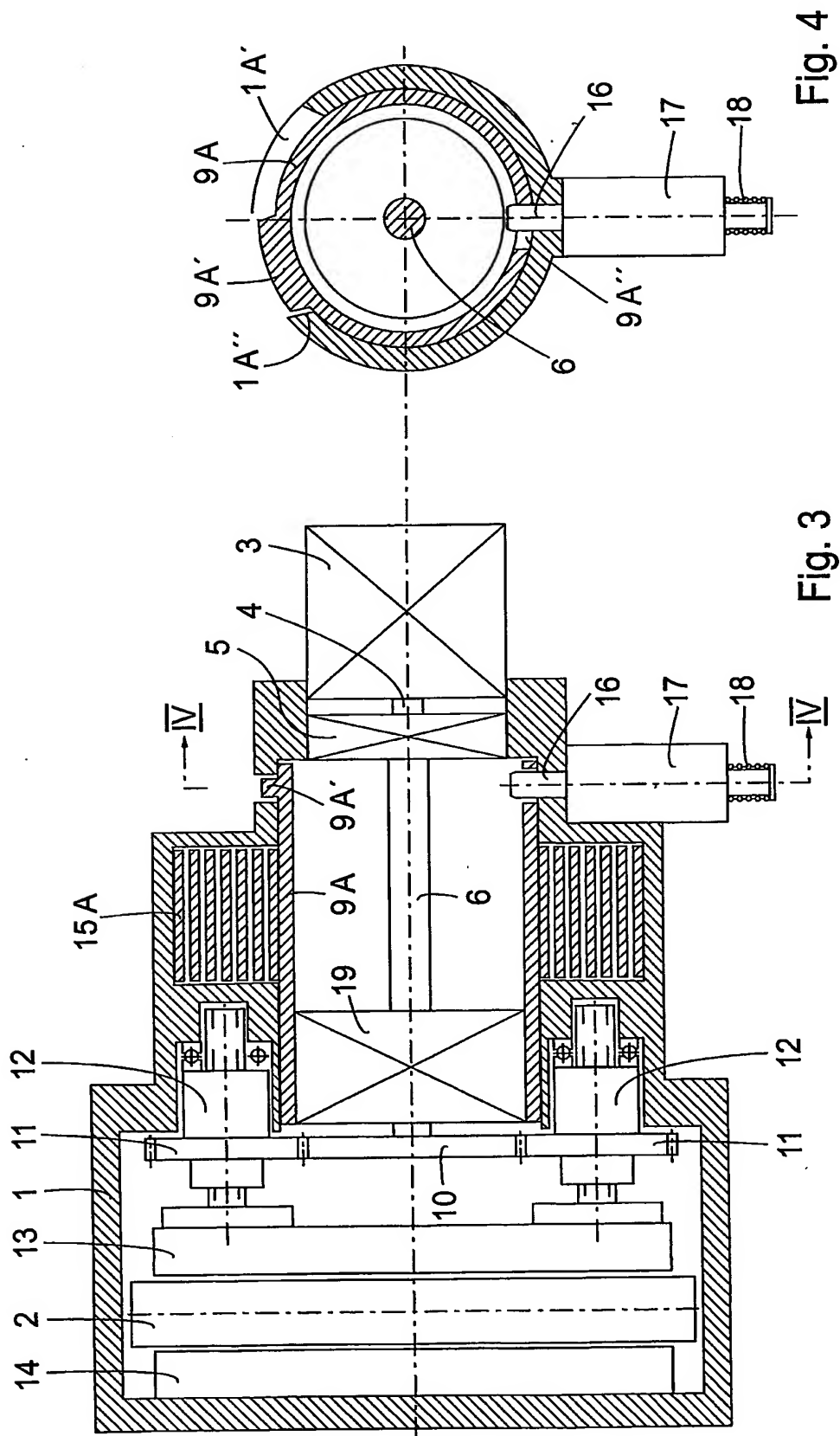
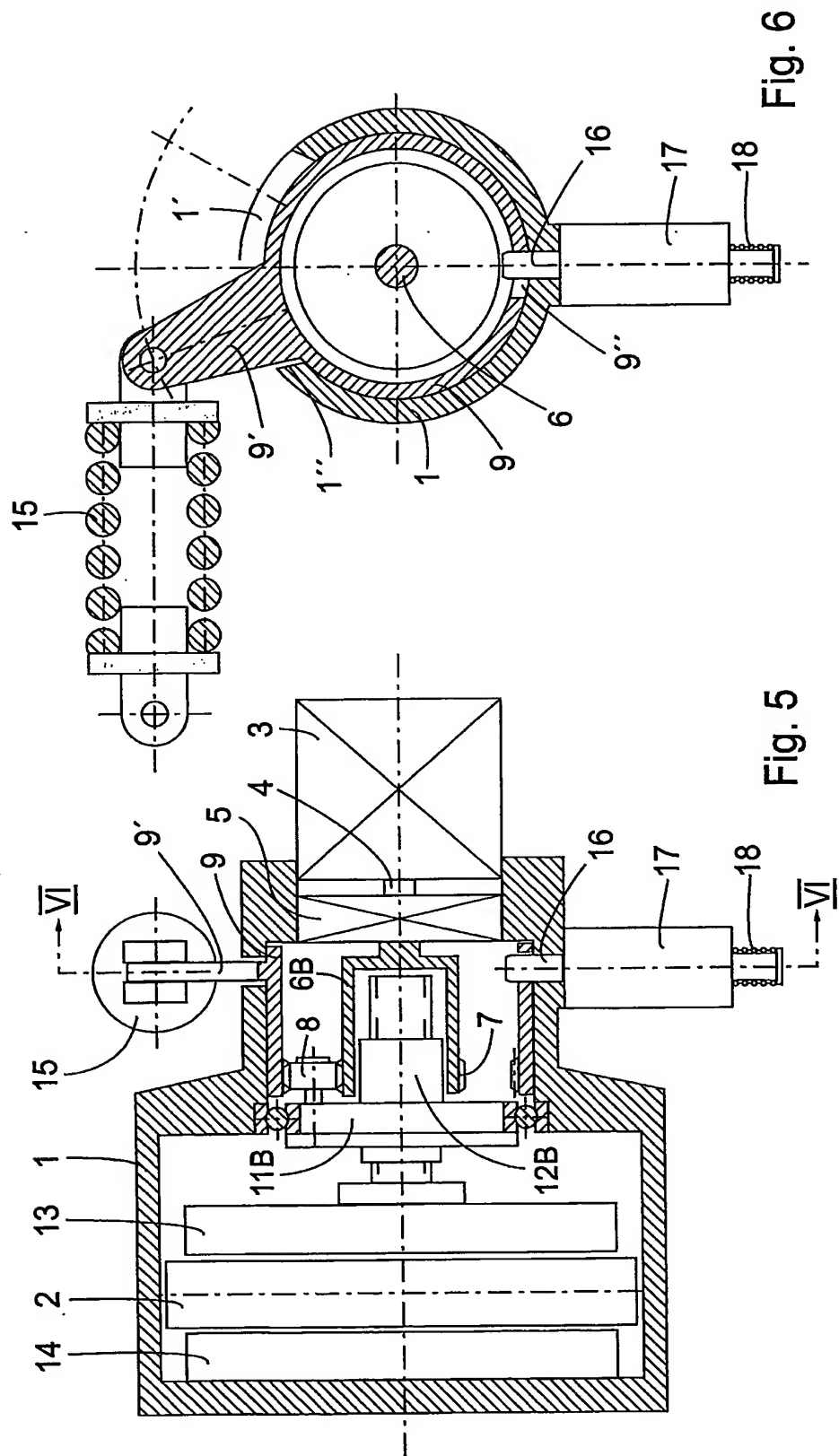


Fig. 4

Fig. 3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 02/02363

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F16D 65/21, F16D 65/54

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B60T, F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 19851668 A1 (ROBERT BOSCH GMBH), 11 May 2000 (11.05.00), column 4, line 8 - line 25, figure 3, abstract --	1,9
A	US 5829845 A (MARON ET AL), 3 November 1998 (03.11.98), column 5, line 31 - line 65, figure 2a, abstract --	1,4-7
A	US 5004077 A (CARLSON ET AL), 2 April 1991 (02.04.91), figure 1, abstract --	1,3,9

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 19908062 A1 (CONTINENTAL TEVES AG & CO OHG), 31 August 2000 (31.08.00), figure 1, abstract --	1,2,4,6,7
A	DE 19744356 C1 (CONTINENTAL AKTIENGESELLSCHAFT), 7 January 1999 (07.01.99), figure 1b, abstract -- -----	1,3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 02/02363

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
DE	19851668	A1	11/05/00	JP	2000145844 A	26/05/00
US	5829845	A	03/11/98	DE	19601983 C	24/07/97
				DE	59703373 D	00/00/00
				EP	0785120 A,B	23/07/97
US	5004077	A	02/04/91	AU	5530890 A	18/04/91
				WO	9104167 A	04/04/91
DE	19908062	A1	31/08/00	NONE		
DE	19744356	C1	07/01/99	EP	0908642 A	14/04/99
				JP	11201204 A	27/07/99